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Review Article

From Pitta to Cytokines: An Integrative Review of Ayurvedic and Modern Mechanisms of Inflammation

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Abstract

Background: Inflammation is a central pathological process underlying a wide spectrum of acute and chronic diseases, including cardiovascular, autoimmune, and metabolic disorders. While modern immunology has elucidated key molecular mediators such as cytokines, oxidative stress, and signaling pathways like nuclear factor kappa B (NF-κB), current therapeutic approaches often remain limited to symptomatic control. Ayurveda, a traditional system of medicine, conceptualizes inflammation through systemic constructs such as Pitta (heat and transformation), Ama (toxic metabolic byproducts), and Agni (metabolic capacity), offering a holistic perspective on disease pathogenesis.
Methods: A comprehensive literature search was conducted across PubMed, Scopus, and Google Scholar up to January 2026 using keywords related to Ayurveda, inflammation, cytokines, oxidative stress, and immunomodulation. Eligible studies included experimental, clinical, and review articles published in English. Data were qualitatively synthesized to identify conceptual correlations and mechanistic overlaps between Ayurvedic principles and modern immunology.
Results: Key Ayurvedic concepts demonstrated plausible parallels with biological processes in inflammation. Pitta was associated with pro-inflammatory cytokine activity, Ama with endotoxins and reactive oxygen species, and Agni with metabolic regulation. Several Ayurvedic interventions, including curcumin, Ashwagandha, and Guduchi, exhibited anti-inflammatory and immunomodulatory effects through mechanisms such as NF-κB inhibition, antioxidant activity, and immune regulation. These findings support a convergent model in which metabolic dysfunction and immune activation are interconnected drivers of inflammation.
Conclusion: Integrating Ayurvedic principles with modern immunological insights provides a comprehensive understanding of inflammation as a systemic process. This approach highlights the potential of combining traditional knowledge with molecular science to advance preventive and therapeutic strategies, while emphasizing the need for rigorous clinical validation and standardization.

Keywords: Inflammation, Cytokines, Ayurveda, Immunomodulation, NF-kB

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Introduction

Inflammation is a fundamental biological response to injury and infection, essential for host defense and tissue repair.[1] However, when dysregulated or persistent, it becomes a central driver of numerous chronic diseases, including cardiovascular disorders, autoimmune conditions, metabolic syndrome, and neurodegenerative diseases.[2] In recent decades, advances in immunology have elucidated the molecular underpinnings of inflammation, highlighting the roles of pro-inflammatory cytokines, oxidative stress, and signaling pathways such as nuclear factor kappa B (NF-κB).[3] Despite these insights, current therapeutic strategies often focus on symptomatic suppression rather than addressing the complex, systemic nature of chronic inflammation, and may be associated with adverse effects and incomplete disease resolution.
This has led to a growing interest in integrative approaches that consider inflammation as a multifaceted, system-level phenomenon. Ayurveda, one of the oldest systems of medicine, offers a holistic framework in which inflammatory processes are understood through concepts such as Pitta (associated with heat and transformation), Ama (toxic metabolic byproducts), and Agni (digestive and metabolic capacity).[4] Rather than isolating inflammation as a localized event, Ayurveda conceptualizes it as a consequence of systemic imbalance, linking metabolic dysfunction, toxin accumulation, and tissue susceptibility.

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While these traditional concepts differ in terminology from modern biomedical language, emerging evidence suggests potential parallels between Ayurvedic principles and contemporary immunological mechanisms. For instance, the concept of Ama may correspond to endotoxins and reactive metabolic intermediates,[5] whereas Pitta imbalance may reflect heightened inflammatory signaling.[6] Additionally, several Ayurvedic interventions, including herbal formulations, have demonstrated measurable anti-inflammatory and immunomodulatory effects at the molecular level.

Despite increasing interest, there remains a lack of structured efforts to systematically integrate Ayurvedic concepts with modern immunology in a mechanistic and evidence-based manner. Bridging this gap could provide a more comprehensive understanding of inflammation and support the development of novel, integrative therapeutic strategies.

Therefore, this review aims to synthesize and map key Ayurvedic concepts of inflammation with established immunological pathways, offering an integrative framework that connects traditional knowledge with contemporary biomedical science.

Methods

This integrative review was conducted to systematically identify and synthesize literature exploring the conceptual and mechanistic relationships between Ayurvedic principles and modern immunological frameworks of inflammation.

Search Strategy

A comprehensive literature search was performed across electronic databases, including PubMed, Scopus, and Google Scholar, from inception to January 2026. The search strategy combined keywords and Medical Subject Headings (MeSH) related to both domains, including “Ayurveda,” “Pitta,” “Ama,” “Agni,” “inflammation,” “cytokines,” “NF-κB,” “oxidative stress,” and “immunomodulation.” Boolean operators (AND, OR) were used to refine the search and ensure comprehensive coverage.

Study Selection Criteria

Studies were selected based on predefined inclusion and exclusion criteria.

Inclusion criteria:

- Articles published in English
- Experimental studies (in vitro, in vivo), clinical studies, and review articles
- Studies addressing inflammatory pathways, immune mechanisms, or anti-inflammatory effects of Ayurvedic concepts.
- Peer-reviewed publications with accessible full text

Exclusion criteria:

- Non-scientific or anecdotal literature
- Articles lacking relevance to inflammation or immunological mechanisms
- Duplicate publications or studies with insufficient methodological clarity

Data Extraction and Synthesis

Relevant data were extracted and categorized into three domains: (1) Ayurvedic conceptual frameworks, (2) modern immunological mechanisms of inflammation, and (3) pharmacological and molecular effects of Ayurvedic interventions. Key findings were qualitatively synthesized to identify conceptual parallels and mechanistic overlaps.

Integrative Approach

Rather than conducting a purely comparative analysis, this review employed an integrative framework aimed at mapping Ayurvedic concepts to corresponding biological processes in modern immunology. Emphasis was placed on identifying plausible mechanistic correlations supported by experimental or clinical evidence, particularly in relation to inflammatory pathways, cytokine activity, oxidative stress, and metabolic dysregulation.

Integrative Mapping of Ayurvedic Concepts and Modern Immunological Mechanisms

Understanding inflammation through a unified framework requires bridging traditional Ayurvedic concepts with established molecular and immunological pathways. While Ayurveda describes disease processes using systemic and functional principles, modern immunology characterizes inflammation through cellular mediators and biochemical signaling. Despite differences in terminology, several conceptual parallels can be identified, suggesting a potential convergence of these two paradigms.

Conceptual Correlation Between Ayurveda and Immunology

The Ayurvedic concept of Pitta, associated with heat, transformation, and metabolic activity, can be correlated with pro-inflammatory processes in modern medicine.[6] Increased Pitta is characterized by signs such as redness, heat, and inflammation, which parallel the biological effects of elevated cytokines such as tumor necrosis factor-alpha (TNF-α), interleukin-1 (IL-1), and interleukin-6 (IL-6).[7,8] These cytokines are central mediators of the inflammatory response and contribute to tissue damage and systemic inflammation when dysregulated.

Similarly, Ama, described as a toxic byproduct of impaired digestion and metabolism, may be conceptually aligned with endotoxins, reactive oxygen species (ROS), and other pro-inflammatory metabolic intermediates.[5] The accumulation of Ama is believed to obstruct physiological channels (srotas) and trigger systemic inflammation. This bears resemblance to the role of gut-derived endotoxins and oxidative stress in promoting chronic low-grade inflammation and immune activation.[9]

Agni, representing digestive and metabolic capacity, plays a central role in maintaining physiological balance in Ayurveda.[10] Impaired Agni leads to the formation of Ama and subsequent disease progression. In modern terms, this can be associated with metabolic dysfunction, including impaired mitochondrial activity, altered energy homeostasis, and insulin resistance, all of which are known to contribute to inflammatory states.[11]

Furthermore, the concept of Dhatu (tissue integrity) provides an additional layer of integration. Chronic inflammation in modern medicine leads to progressive tissue damage and dysfunction, which parallels the Ayurvedic understanding of Dhatu kshaya (tissue depletion) resulting from prolonged imbalance.[12]

Table 1. Comparative Mapping

Ayurvedic Concept	Functional Description	Modern Correlate	Biological Basis
Pitta	Heat, transformation, inflammation	Pro-inflammatory cytokines	TNF-α, IL-1, IL-6
Ama	Toxic metabolic byproducts	Endotoxins, ROS	Oxidative stress, gut-derived toxins

Agni	Digestive/metabolic capacity	Metabolic regulation	Mitochondrial function, insulin sensitivity
Srotas obstruction	Blockage of physiological channels	Microvascular dysfunction	Impaired circulation, inflammation
Dhatu kshaya	Tissue depletion	Tissue damage	Chronic inflammation, catabolism

Proposed Integrative Model of Inflammation

A unified model can be conceptualized wherein impaired Agni leads to the accumulation of Ama, which in turn aggravates Pitta, resulting in systemic inflammation. This progression mirrors the modern understanding in which metabolic dysfunction leads to the accumulation of reactive intermediates and endotoxins, triggering inflammatory signaling pathways such as NF-κB activation and cytokine release. Sustained activation of these pathways ultimately results in tissue damage and chronic disease.
This integrative framework highlights that both Ayurveda and modern immunology recognize inflammation not merely as an isolated event, but as a systemic process driven by underlying metabolic and regulatory disturbances. While Ayurveda emphasizes functional imbalance and systemic toxicity, modern medicine provides molecular specificity, together offering a more comprehensive understanding of inflammatory pathophysiology.

Ayurvedic Interventions and Molecular Mechanisms in Inflammation

Ayurvedic therapeutics aim not only to alleviate symptoms but to restore systemic balance by correcting underlying metabolic and immunological disturbances.[13] Increasing evidence suggests that several Ayurvedic herbs and formulations exert measurable anti-inflammatory and immunomodulatory effects through well-defined molecular pathways, providing a biological basis for their traditional use.[14]

Herbal Interventions and Molecular Targets

A number of widely used Ayurvedic herbs have demonstrated significant anti-inflammatory activity in experimental and clinical studies.[15,16]
Curcumin, the principal bioactive compound of Curcuma longa (turmeric), is one of the most extensively studied natural anti-inflammatory agents.[17] It exerts its effects primarily through inhibition of the nuclear factor kappa B (NF-κB) signaling pathway, thereby reducing the transcription of pro-inflammatory cytokines such as TNF-α, IL-1, and IL-6. Additionally, curcumin exhibits antioxidant properties by scavenging reactive oxygen species and enhancing the activity of endogenous antioxidant enzymes.
Ashwagandha (Withania somnifera) has been shown to possess immunomodulatory and adaptogenic properties.[18] Its active constituents, including withanolides, modulate immune responses by reducing cortisol levels and regulating inflammatory mediators. Experimental studies indicate its role in attenuating stress-induced inflammation and improving immune homeostasis.
Guduchi (Tinospora cordifolia) is recognized for its immunostimulatory effects.[19] It enhances macrophage activation, promotes phagocytosis, and modulates cytokine production, thereby contributing to improved immune surveillance and regulation. Its antioxidant activity further supports its role in mitigating oxidative stress-associated inflammation.

Polyherbal Formulations and Synergistic Effects

Ayurveda frequently employs polyherbal formulations, which may exert synergistic effects on multiple biological pathways.[20] Triphala, a classical formulation composed of Emblica officinalis, Terminalia chebula, and Terminalia bellirica, has demonstrated potent antioxidant and anti-inflammatory properties. It has been shown to reduce oxidative stress, modulate gut microbiota, and inhibit inflammatory mediators, thereby addressing both the source and consequences of inflammation. Such multi-targeted approaches align with the Ayurvedic principle of restoring systemic balance, in contrast to the single-target strategies often employed in conventional pharmacotherapy.[21]

Mechanistic Insights into Anti-Inflammatory Action

The anti-inflammatory effects of Ayurvedic interventions can be broadly categorized into three interconnected mechanisms:

1. Inhibition of Pro-inflammatory Signaling Pathways: Several herbal compounds, particularly curcumin, inhibit key signaling pathways such as NF-κB, thereby reducing cytokine production and inflammatory gene expression.
2. Antioxidant Activity and Reduction of Oxidative Stress: Many Ayurvedic herbs neutralize reactive oxygen species and enhance endogenous antioxidant defenses, limiting cellular damage and inflammatory amplification.
3. Immunomodulation and Homeostatic Regulation: Rather than purely suppressing inflammation, Ayurvedic interventions often modulate immune responses, promoting balance between pro- and anti-inflammatory pathways.

Integration with the Ayurvedic Framework

From an Ayurvedic perspective, these interventions can be interpreted as restoring Agni, reducing Ama, and pacifying aggravated Pitta. From a biomedical standpoint, this corresponds to improving metabolic efficiency, reducing toxic intermediates, and regulating inflammatory signaling pathways.
This dual interpretation reinforces the concept that Ayurvedic therapeutics may operate through mechanisms that are increasingly being validated by modern scientific research, supporting their role in integrative approaches to inflammation management.

Clinical Implications of an Integrative Inflammatory Framework

The integration of Ayurvedic principles with modern immunological understanding offers a broader and more nuanced perspective on the prevention and management of chronic inflammatory diseases. By combining systemic insights from Ayurveda with molecular precision from modern medicine, this approach has the potential to enhance both therapeutic outcomes and preventive strategies.

Chronic Inflammatory Diseases

Chronic low-grade inflammation is a central feature of several major disease categories, including cardiovascular diseases, autoimmune disorders, and metabolic syndromes. Conventional management strategies often rely on long-term pharmacological interventions aimed at suppressing inflammation, which may be associated with adverse effects and variable efficacy.

An integrative framework allows for a more comprehensive approach. For instance, in cardiovascular diseases such as acute coronary syndrome, inflammation plays a pivotal role in atherosclerotic plaque instability and progression.[22] From an Ayurvedic perspective, this may be interpreted as Pitta aggravation and Ama accumulation, contributing to vascular dysfunction. Interventions targeting metabolic balance (Agni) and reducing systemic inflammatory load may complement standard therapies, potentially improving long-term outcomes.

Similarly, autoimmune diseases, characterized by dysregulated immune responses and persistent inflammation, may benefit from immunomodulatory strategies rather than purely immunosuppressive approaches.[23] Ayurvedic interventions such as Ashwagandha and Guduchi, which have demonstrated immunoregulatory properties, may offer supportive roles in restoring immune balance while minimizing systemic toxicity.

Metabolic and Lifestyle Disorders

Metabolic syndrome, obesity, and type 2 diabetes are increasingly recognized as inflammatory conditions driven by metabolic dysregulation and oxidative stress. The Ayurvedic concept of impaired Agni leading to Ama accumulation closely parallels the modern understanding of insulin resistance, mitochondrial dysfunction, and chronic low-grade inflammation. Integrative strategies focusing on dietary regulation, herbal supplementation, and lifestyle modifications may address both metabolic and inflammatory pathways simultaneously. This dual-action approach is particularly relevant in long-term disease management, where lifestyle factors play a critical role.

Preventive and Personalized Medicine

One of the most significant contributions of Ayurveda lies in its emphasis on prevention and individualized care. Concepts such as Prakriti (individual constitution) allow for personalized therapeutic strategies, which align with emerging trends in precision medicine. By identifying individuals at higher risk of inflammatory disorders and implementing early interventions aimed at maintaining metabolic balance and reducing inflammatory triggers, it may be possible to prevent disease onset or delay progression. This preventive approach is especially valuable in populations with a high burden of lifestyle-related diseases.

Towards Integrative Therapeutic Models

The integration of Ayurvedic and modern approaches does not imply replacement but rather complementarity. Conventional therapies provide rapid and targeted control of acute inflammation, while Ayurvedic interventions may offer sustained regulation of underlying metabolic and immunological processes. Such a model encourages a shift from disease-centric to system-centric care, where inflammation is addressed not only as a pathological endpoint but as a dynamic process influenced by metabolism, immunity, and environmental factors.

Challenges and Limitations

Despite the conceptual and emerging mechanistic alignment between Ayurvedic principles and modern immunology, several challenges limit the direct translation of this integrative framework into clinical practice. A primary limitation is the lack of standardization in Ayurvedic formulations. Variability in plant sources, preparation methods, and dosing regimens can lead to inconsistent pharmacological effects, making reproducibility difficult across studies. This heterogeneity poses a significant barrier to large-scale validation and regulatory acceptance. Additionally, while a growing body of experimental research supports the anti-inflammatory and immunomodulatory properties of Ayurvedic interventions, there remains a paucity of high-quality randomized controlled trials (RCTs). Many available studies are limited by small sample sizes, methodological variability, or inadequate blinding, reducing the strength of clinical evidence.

Another critical challenge lies in the translation of Ayurvedic concepts into biomedical terminology. Concepts such as Pitta, Ama, and Agni are inherently qualitative and context-dependent, making direct equivalence with molecular markers complex. While integrative mapping provides a useful framework, it may oversimplify nuanced traditional principles or risk overinterpretation. Furthermore, potential herb–drug interactions and safety considerations must be carefully evaluated, particularly when integrating Ayurvedic therapies with conventional pharmacological treatments. The absence of robust pharmacovigilance data in many settings further complicates this issue.

Finally, there is a need for interdisciplinary collaboration between practitioners of Ayurveda, biomedical researchers, and clinicians. Without such collaboration, integrative approaches risk remaining theoretical rather than being translated into evidence-based clinical practice.

Conclusion and Future Directions

This integrative review highlights that, despite differences in language and conceptual frameworks, Ayurveda and modern immunology share converging perspectives on inflammation as a systemic and multifactorial process. Ayurvedic concepts such as Pitta, Ama, and Agni provide a functional understanding of inflammatory states, while modern immunology offers molecular specificity through cytokine signaling, oxidative stress pathways, and immune regulation.

Bridging these paradigms enables a more comprehensive model of inflammation—one that connects metabolic dysfunction, immune activation, and tissue damage within a unified framework. Importantly, the growing body of evidence supporting the molecular actions of Ayurvedic interventions, including anti-inflammatory, antioxidant, and immunomodulatory effects, reinforces their potential role in integrative healthcare.

Looking forward, future research should focus on rigorous clinical validation through well-designed randomized controlled trials, as well as the development of standardized formulations and dosing protocols. Advances in systems biology, metabolomics, and biomarker-driven research may further facilitate the translation of Ayurvedic concepts into measurable biological parameters.
Moreover, the integration of artificial intelligence and data-driven approaches holds promise in correlating traditional phenotypic classifications with molecular and clinical profiles, paving the way for truly personalized medicine.
In conclusion, an integrative approach to inflammation that combines the systemic insights of Ayurveda with the mechanistic precision of modern immunology has the potential to enhance both preventive and therapeutic strategies. Rather than functioning as parallel systems, these paradigms may be more effectively viewed as complementary frameworks contributing to a more holistic understanding of human health and disease.

Declarations

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References

1. Choi B, Lee C, Yu JW. Distinctive role of inflammation in tissue repair and regeneration. Arch Pharm Res. 2023 Feb;46(2):78-89. doi: 10.1007/s12272-023-01428-3
2. Furman D, Campisi J, Verdin E, et al. Chronic inflammation in the etiology of disease across the life span. Nat Med. 2019 Dec;25(12):1822-1832. doi: 10.1038/s41591-019-0675-0
3. Liu S, Liu J, Wang Y, et al. Oxidative Stress: Signaling Pathways, Biological Functions, and Disease. MedComm (2020). 2025 Jul 1;6(7):e70268. doi: 10.1002/mco2.70268
4. Sumantran VN, Tillu G. Cancer, inflammation, and insights from ayurveda. Evid Based Complement Alternat Med. 2012;2012:306346. doi: 10.1155/2012/306346
5. Pandey P, Rastogi S, Lawrence A, et al. Development and validation of an ama instrument for assessing the disease activity on the basis of constitutional features in Amavata (Rheumatoid Arthritis). J Ayurveda Integr Med. 2023 Mar-Apr;14(2):100689. doi: 10.1016/j.jaim.2023.100689
6. Mills PJ, Peterson CT, Wilson KL, et al. Relationships among classifications of ayurvedic medicine diagnostics for imbalances and western measures of psychological states: An exploratory study. J Ayurveda Integr Med. 2019 Jul-Sep;10(3):198-202. doi: 10.1016/j.jaim.2018.02.001
7. Saim FI, Sjamsudin E, Najmi N. The Role of Inflammatory Biomarkers (IL-1, IL-6, TNF-α, and Alpha-Amylase) in Saliva on Post-Odontectomy Swelling: A Rapid Review. J Inflamm Res. 2025 Sep 4;18:12227-12243. doi: 10.2147/JIR.S536809
8. Fukuda H, Sakuma Y, Inage K, et al. Tumor Necrosis Factor-Alpha (TNF-α) and Interleukin-6 (IL-6) Cytokines in the Injured Meniscus of Patients With Knee Subchondral Insufficiency Fractures: A Potential Association With Preoperative Pain. Cureus. 2025 Jan 20;17(1):e77734. doi: 10.7759/cureus.77734
9. Roszak K, Roy K, Sobocińska J, et al. Endotoxin's Impact on Organism: From Immune Activation to Tolerance and Beyond. J Clin Med. 2025 Sep 14;14(18):6478. doi: 10.3390/jcm14186478
10. Agrawal AK, Yadav CR, Meena MS. Physiological aspects of Agni. Ayu. 2010 Jul;31(3):395-8. doi: 10.4103/0974-8520.77159
11. Choi W, Woo GH, Kwon TH, et al. Obesity-Driven Metabolic Disorders: The Interplay of Inflammation and Mitochondrial Dysfunction. Int J Mol Sci. 2025 Oct 6;26(19):9715. doi: 10.3390/ijms26199715
12. Sharma V, Chaudhary AK. Concepts of Dhatu Siddhanta (theory of tissues formation and differentiation) and Rasayana; probable predecessor of stem cell therapy. Ayu. 2014 Jul-Sep;35(3):231-6. doi: 10.4103/0974-8520.153731
13. Vallish BN, Dang D, Dang A. Nature and mechanism of immune boosting by Ayurvedic medicine: A systematic review of randomized controlled trials. World J Methodol. 2022 May 20;12(3):132-147. doi: 10.5662/wjm.v12.i3.132
14. Moudgil KD, Venkatesha SH. The Anti-Inflammatory and Immunomodulatory Activities of Natural Products to Control Autoimmune Inflammation. Int J Mol Sci. 2022 Dec 21;24(1):95. doi: 10.3390/ijms24010095
15. Vakiti S, Farriss L, Mehta H, et al. The Efficacy of Ayurvedic Herbs in the Prevention and Treatment of Inflammatory Bowel Disease: A Scoping Review. Cureus. 2025 May 19;17(5):e84410. doi: 10.7759/cureus.84410
16. Shaikh RU, Pund MM, Gacche RN. Evaluation of anti-inflammatory activity of selected medicinal plants used in Indian traditional medication system *in vitro* as well as *in vivo*. J Tradit Complement Med. 2015 Aug 1;6(4):355-361. doi: 10.1016/j.jtcme.2015.07.001
17. Sharifi-Rad J, Rayess YE, Rizk AA, et al. Turmeric and Its Major Compound Curcumin on Health: Bioactive Effects and Safety Profiles for Food, Pharmaceutical, Biotechnological and Medicinal Applications. Front Pharmacol. 2020 Sep 15;11:01021. doi: 10.3389/fphar.2020.01021
18. Mikulska P, Malinowska M, Ignacyk M, et al. Ashwagandha *(Withania somnifera)*-Current Research on the Health-Promoting Activities: A Narrative Review. Pharmaceutics. 2023 Mar 24;15(4):1057. doi: 10.3390/pharmaceutics15041057
19. Gupta A, Gupta P, Bajpai G. *Tinospora cordifolia (Giloy)*: An insight on the multifarious pharmacological paradigms of a most promising medicinal ayurvedic herb. Heliyon. 2024 Feb 15;10(4):e26125. doi: 10.1016/j.heliyon.2024.e26125

20. Sharma S, Baboota S, Amin S, et al. Ameliorative effect of a standardized polyherbal combination in methotrexate-induced nephrotoxicity in the rat. Pharm Biol. 2020 Dec;58(1):184-199. doi: 10.1080/13880209.2020.1717549
21. Bairwa VK, Kashyap AK, Meena P, et al. Triphala's characteristics and potential therapeutic uses in modern health. Int J Physiol Pathophysiol Pharmacol. 2025 Apr 25;17(2):19-36. doi: 10.62347/OBSS5026
22. Henein MY, Vancheri S, Longo G, et al. The Role of Inflammation in Cardiovascular Disease. Int J Mol Sci. 2022 Oct 26;23(21):12906. doi: 10.3390/ijms232112906
23. Lee B, Yoo J, Lee HS, et al. Targeted-Immunomodulatory Nanomedicines for the Treatment of Autoimmune Diseases via Multiple Administration Routes. Int J Nanomedicine. 2025 Dec 27;20:15493-15514. doi: 10.2147/IJN.S558540

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